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The Role of Anxiety in Learning Minitrampoline Jumping

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In the psychological literature a distinction is frequently made between two types of anxiety. The first type is conceived as a relatively stable and permanent personality trait or disposition. The second type refers to the momentary and transient emotional reactions that are exhibited in situations subjectively perceived as threatening.

According to Spielberger (1972), these emotional reactions, or *state anxiety*, are characterized by "feelings of tension and apprehension, and by heightened autonomic nervous system activity." Anxiety as a personality trait, or *trait anxiety*, refers to the disposition to react with more or less state anxiety in a diversity of situations.

The present experiment was designed to investigate the relationships between anxiety and motor performance in children. The motor task in question consisted of a running two-footed jump with an extended body from a minitrampoline (trampette). Anxiety was measured with questionnaires operationalizing state anxiety and trait anxiety, and with a questionnaire measuring specific anxiety for minitrampoline jumping.

It was hypothesized that a negative relationship would exist between state anxiety and specific anxiety on one hand, and both motor performance and motor learning on the other. This hypothesis is based on the characteristics of anxiety. For example, Cattell (1972) describes anxiety as a state wherein variables such as raised irritability, lack of self-confidence, reduction of fluency, and sense of guilt covary in combination. One might expect such a combination of variables to lead to a decrease in performance level.

Furthermore, anxiety has a negative influence on information-processing capacity and causes changes in attentional processes, the anxiety reaction drawing the subject's attention. For these reasons, a negative effect of anxiety on performance proficiency was predicted. With respect to trait anxiety it was predicted that a negative relationship with motor performance and learning would only appear in situations being experienced as subjectively threatening.

Methods

Subjects

Subjects were 113 boys (aged 9 to 14 years) with no prior experience in minitrampoline jumping.

Questionnaires

In the initial phase of the study subjects completed questionnaires and written tests in their classroom. The following questionnaires are relevant:

- A Dutch adaptation of Spielberger's Trait Anxiety Inventory for Children (STAIC-Trait; Bakker & van Wieringen, 1984a)
- A questionnaire measuring specific anxiety associated with minitrampoline jumping (Trampoline Anxiety)

Apparatus

The second phase of the study took place in a gymnasium. Jumps were performed from a Rogym trampette. All were filmed with a high-speed 16-mm camera, type Actionmaster 500, Model 1 PD (Photo Sonics, California). Films were shot with 56 frames per second and analyzed by means of a NAC film motion analyzer (Model 76 Data Analyzer).

Procedure in the Gymnasium

Subjects were divided at random into three groups, differing with regard to the way they were instructed. All instructions were delivered individually and intended to create a neutral, an ego-threatening, or a physically threatening condition.

Induction of ego threat was pursued by stressing to the children the fact that the jumps would be filmed (which they were) and that the films would be observed by children excelling in trampette jumping. In order to induce physical threat, subjects were told that eventually they would be required to perform running somersaults from the trampette (which they had the opportunity, but were not required, later to do).

After receiving instructions but before actually starting the training session, the subjects filled out a Dutch adaptation of Spielberger's STAIC-State (Bakker & van Wieringen, 1984a). After having completed the STAIC-State, the subjects watched two demonstrations of the running two-footed jump and then performed 35 of these jumps themselves, the jumps being divided in seven blocks of five trials each. Between trial blocks there were 3-min intervals during which subjects evaluated loop films of minitrampoline jumping. Just before subjects started a new block of five trials, the experimenter demonstrated one more jump. During the trial blocks the experimenter commented upon the subjects' performance in as standardized a way as feasible.

As mentioned before, all jumps were filmed and subjected to motion analysis. This resulted in measures for the following eight performance aspects of every jump:

1. Runtime: time spent on last 2 m of the run
2. Takeoff distance: distance between takeoff point and trampette
3. Height onto: height of jump onto trampette
4. Contact point: location of coming down onto and taking off from trampette
5. Height of jump: height of jump from trampette
6. Knee angle: angle between upper and lower leg at highest point of jump from trampette
7. Angle trunk: angle between trunk and horizontal plane at highest point of jump from trampette
8. Distance jump: distance of jump from trampette

Three expert judges were requested to rate and, 3 weeks later, to rerate the overall impressions of 210 jumps on a rating scale from 0 (extremely bad performance) to 100 (extremely good performance). These 210 jumps consisted of all 35 jumps of 5 randomly chosen subjects and one jump of each of 35 other subjects. Before being rated by the judges, the 210 jumps were transmitted from film to videotape.

Results

Reliability of both the scoring of the eight aforementioned performance aspects and the global expert ratings were satisfactory (for detailed information, see Bakker & van Wieringen, 1984a). Multiple regression analyses, using the eight aspects of the jumps as predictor variables and the expert ratings as criterion variables showed Height of Jump to be the aspect accounting for the greatest percentage of variance in the criterion scores. Other performance aspects did not contribute substantially to improving the prediction of the criterion. The product-moment correlations between Height of Jump and the expert ratings are presented in Table 1. Because of these results, Height of Jump has been taken as the operationalization of performance proficiency, and the other aspects of the jump have not been used in subsequent analyses.

Before turning to the relationship between anxiety measures and performance, we first will deal with the effects of the three different instructions on the state anxiety score. It was expected that both the ego-threatening and the physically threatening instructions would result in higher STAIC-State scores than the neutral instruction. This expectation, however, was not completely confirmed. The physically threatening instructions resulted in significantly ($p < .05$) higher STAIC-State scores than both the ego threatening and neutral instructions, but the latter two did not result in different state scores.

For reasons of analysis subjects were divided into three almost equally sized groups with regard to each of the anxiety measures used. These

Table 1 Pearson Correlations Between Height of Jump and Expert Ratings of the Jump

Subject	A-1	A-2	B-1	B-2	C-1	C-2
Sa (35 jumps)	.81	.77	.82	.66	.71	.72
Sb (35 jumps)	.87	.86	.69	.71	.67	.74
Sc (35 jumps)	.74	.77	.80	.77	.73	.70
Sd (35 jumps)	.67	.67	.47	.79	.78	.55
Se (35 jumps)	.43	.28	.07	.36	.52	.19
35 jumps by 35 different subjects	.74	.68	.57	.63	.79	.84

Note. A, B, and C refer to the three expert judges; 1 and 2 refer to their first and second ratings.

anxiety measures were introduced as a second factor into ANOVAs on Height of Jump, besides Instructions as the first factor and Trial Blocks as the third one (on the latter factor repeated measurements were carried out). Instructions had three levels: neutral, ego-threatening, and physically threatening. Anxiety also had three levels: high, medium, and low; and Trial Blocks had seven levels: blocks 1 to 7. Separate ANOVAs were carried out with, respectively, STAIC-Trait, STAIC-State, and Trampoline Anxiety as the second factor. Because of Instructions and STAIC-State not being orthogonal, their interaction can only be interpreted with reservation.

Significant main effects were found for Trampoline Anxiety ($F\,(2{,}96) = 5.31$; $p < .01$) and Trial Blocks ($F\,(2{,}96) = 72.59$; $p < .001$), whereas the interaction between Trial Blocks and STAIC-State was significant as well ($F\,(12{,}576) = 2.12$; $p < .05$). The main effect for STAIC-State showed some trend toward significance ($F\,(2{,}96) = 2.39$; $p < .10$). All other main and interaction effects were not significant ($p > .10$).

Mean Height of Jump as a function of Trial Blocks and both STAIC-State and Trampoline Anxiety are presented in Figures 1 and 2, respectively. In Figures 3 and 4 Height of Jump has again been plotted against STAIC-State and Trampoline Anxiety, but now performance has been averaged over blocks of trials.

Next to the aforementioned ANOVAs, Pearson correlations between the three anxiety measures on one hand and Height of Jump on the other, as well as the intercorrelations between the three, were computed for each of the three instruction groups. They were then averaged over these groups (by making use of Fisher Z transformations). The resulting mean correlation coefficients are presented in Table 2.

The correlations between A-Trait scores and Height of Jump for the differently instructed groups were .03, −.14, and .09, respectively, in groups with neutral, ego-threatening, and physically threatening instruction.

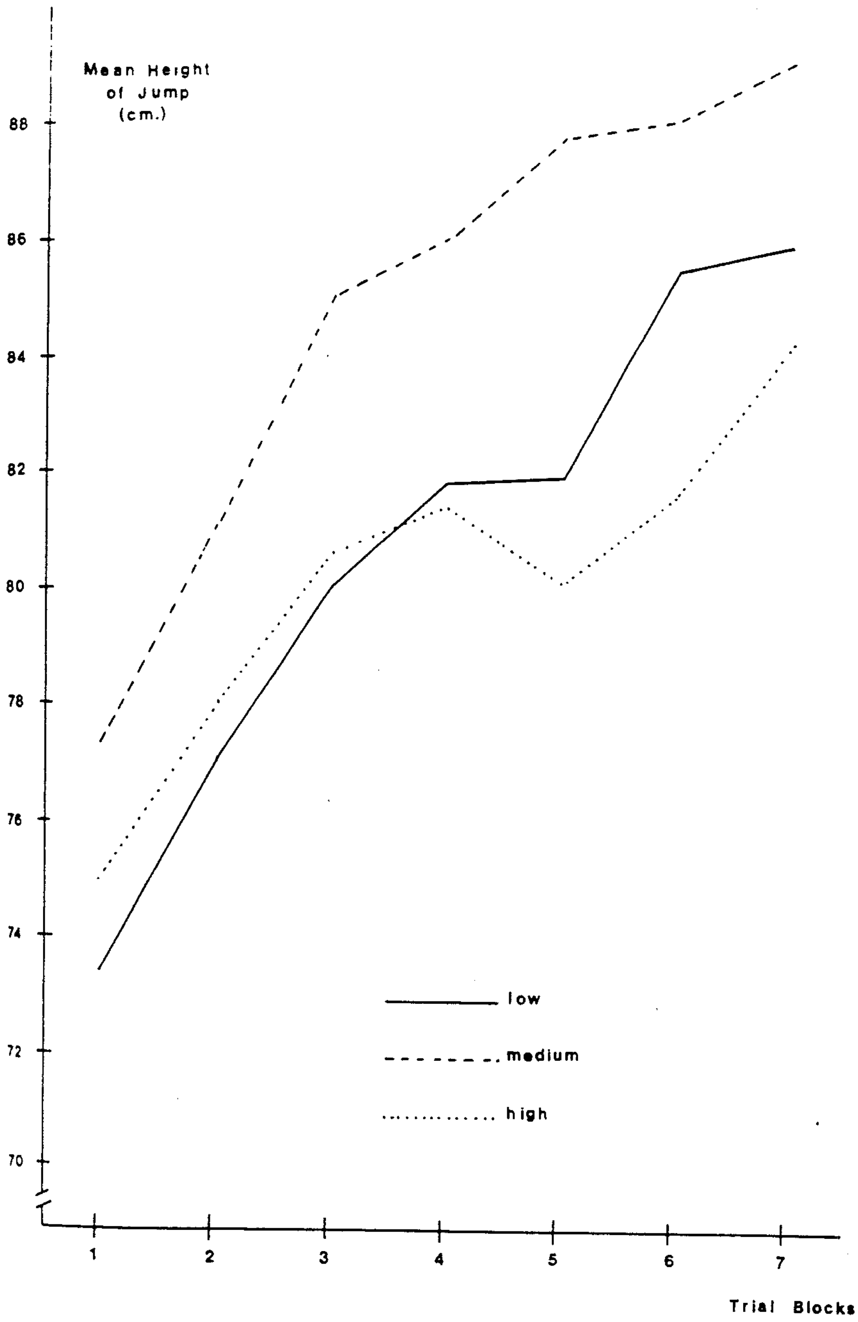

Figure 1 Mean Height of Jump as a function of trial blocks for subjects with low, medium, and high STAIC-State scores.

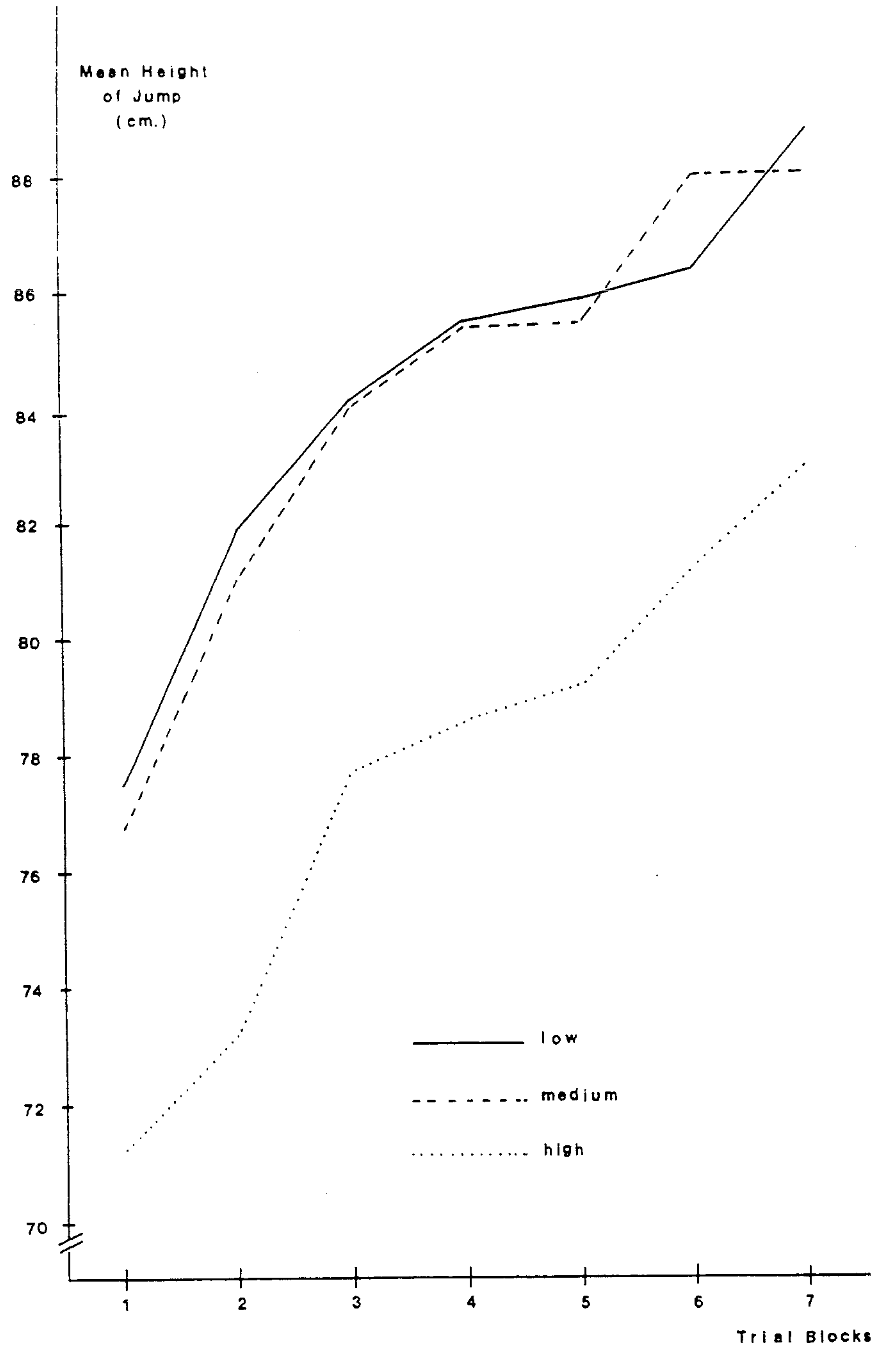

Figure 2 Mean Height of Jump as function of trial blocks for subjects with low, medium, and high "trampoline anxiety" scores.

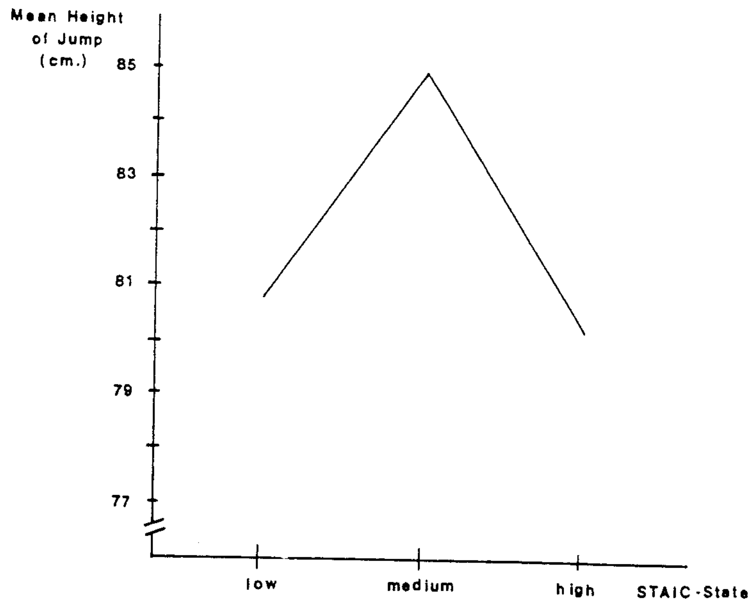

Figure 3 Mean Height of Jump over all trial blocks as a function of STAIC-State anxiety level.

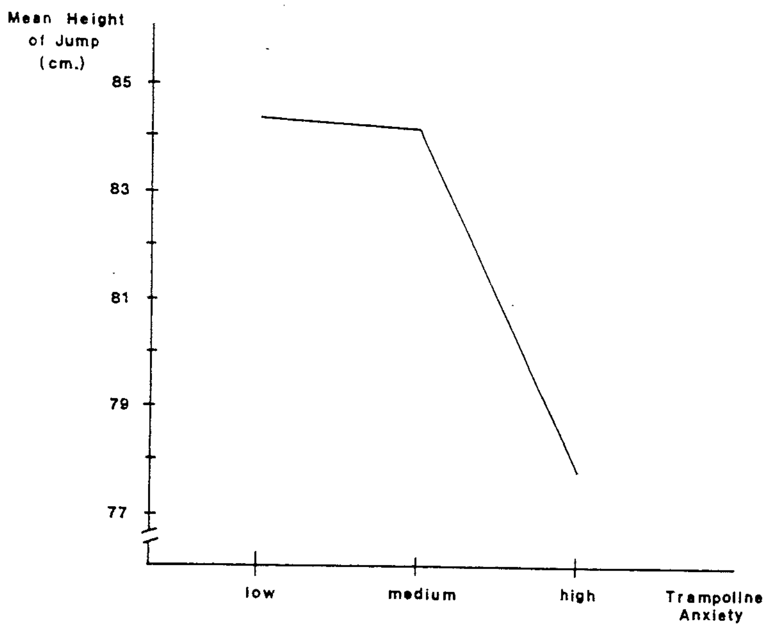

Figure 4 Mean Height of Jump over all trial blocks as a function of "trampoline anxiety" level.

Table 2 Mean Pearson Correlations Between the Three Anxiety Measures and Their Correlations With Height of Jump

Measure	STAIC-State	Trampoline Anxiety	Height of Jump
STAIC-Trait	.30**	.20*	−.07
STAIC-State	—	.16	−.05
Trampoline Anxiety	—	—	−.27**

*$p < .05$. ** $p < .001$.

Discussion

The first finding that deserves mention is the high correlation between overall expert ratings of the jumps and a simple aspect as Height of Jump. An earlier paper already elaborated on this finding (Bakker & van Wieringen, 1984b). In the present context we only emphasize the fact that this result does not imply that the experts based their judgments only on the height of the jump. They themselves reported having based their evaluation on overall performance; there is no reason to doubt this, since several other performance aspects are significantly related to Height of Jump. The high correlations between Height of Jump and the expert ratings, however, enable us to use this aspect of the jump as a significant performance measure operationalizing the quality of the complex movement of the running two-footed jump from the trampette.

The significant main effect of Blocks of Trials on Height of Jump indicated a strong learning effect, which is reflected in the increasing trends of the curves in Figures 1 and 2.

Turning to the relationship between performance and the anxiety measures used, the first thing to be explained is the absence of a significant relationship between STAIC-Trait and motor performance or motor learning. Indeed, no such correlation should be expected for the groups receiving either neutral or ego-threatening instructions (the latter instructions not having induced an increased state anxiety), for trait anxiety is not suited for predicting (motor) performance in the absence of an effective stressor (Martens, 1971, 1977). However, the physically threatening instruction did induce elevated state-anxiety scores, and according to our hypothesis a significant correlation between trait anxiety and performance should have appeared here. It is difficult to account for this negative finding in a convincing way; one reason might be that even in this case the stressor was too mild. In fact, although the difference in state-anxiety scores induced by the physically threatening instruction and the neutral instruction was significant, it was relatively small: 29.7 versus 32.0 on a scale ranging from 20 to 80.

No linear relationship existed between STAIC-State and mean performance (see Table 2). There was a tendency toward an inverted-U relationship as illustrated in Figure 3. However, the STAIC-State main effect in the relevant ANOVA failed to reach the conventional level of significance ($p < .10$). This ANOVA did reveal, however, a significant ($p < .05$) interaction between STAIC-State and Trial Blocks, indicating that performance improved more for subjects with moderate STAIC-State scores than for those having either low or high scores.

Taken together, the results with regard to STAIC-State support the suggestion that moderate state anxiety leads to optimal motor performance and learning, which is contrary to our prediction of decreasing motor efficiency with increasing anxiety. Inverted-U relationships between state anxiety and performance have been reported earlier, however (Adam & van Wieringen, 1983; Klavore, 1978; Weinberg & Ragan, 1978), the explanation being in terms of activation level or arousal. So one might suggest that STAIC-State is more a measure of momentary activation than a measure reflecting the anxiety emotion. The latter interpretation is compatible with the fact that no significant correlation existed between the STAIC-State scores and specific anxiety for minitrampoline jumping (see Table 2).

The task-specific anxiety measure (Trampoline Anxiety) did indeed exhibit a negative linear correlation with performance, as had been predicted (see Table 2). Figure 4 shows that this relatively weak relationship is primarily due to mean performance being worse for subjects with high Trampoline Anxiety than for those with medium and low scores on this variable. Significant negative correlations between motor performance and task-specific anxiety (in the absence of a correlation with more general anxiety measures) have also been reported by Martens (1977) and Rushall (1975).

Tentatively interpreting the results of the present study we suggest that both high arousal (presumably measured by STAIC-State) and high anxiety (as measured with the task-specific test) interfere with motor performance. On the other hand, although low arousal also leads to suboptimal performance, this is not true for low anxiety. This interpretation, however, would have been more convincing if high specific anxiety had also resulted in a decreasing rate of learning, which in fact it did not (see Figure 4).

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